**Ecological impacts of increased nitrogen deposition in semiarid Mediterranean Spain**

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The current and potential impacts of nitrogen deposition on semiarid Mediterranean ecosystems of Europe are still poorly characterised. Since 2007, our group uses a combination of controlled (greenhouse and field experimental conditions) and observational studies to evaluate and predict the impacts of increased nitrogen deposition, alone and/or in combination with alterations in rainfall patterns, on the structure and functioning of grasslands, shrublands and forests from the semiarid portions of Spain. We are particularly interested in how direct responses at the soil (nutrient availability, microbial community composition, and enzyme activities related to the main nutrient cycles) and biocrust/plant levels interact with each other (indirect responses) to produce changes at the ecosystem scale (for example, the ability of semiarid ecosystems to store extra carbon and nitrogen). Our research also focuses on the identification of suitable indicators of increased nitrogen deposition, particularly through the evaluation of enzyme activities measured in widespread species of biocrust-forming mosses and lichens (in particular, *P. squarrosa* and *Cladonia foliacea*).

The field experiment started in October 2007 and has been continuously running until now. It is located in a rosemary-kermes oak shrubland close to Aranjuez (central Spain) and consists in 24 plots divided into 4 treatments (0, 10, 20 and 50 kg N ha-1 yr-1) in a 6-block design. Main lessons from this experiment include the role of the environmental heterogeneity (both in space and time) on the response of semiarid ecosystems to increased nitrogen availability; this environmental variability (e.g., patchy distribution of shrubs and/or availability of micronutrients) often mediates the response of different elements of the ecosystem (e.g. biocrusts and plants) to simulated nitrogen deposition. We have also demonstrated that different forms of inorganic nitrogen (i.e., oxidised vs. reduced) can have different, even opposite, effects; for example, certain annual species can be negatively affected by increased ammonium availability in calcareous soils where nitrate is usually the dominant form of mineral nitrogen.

Future challenges for our group include the evaluation of the impacts of nitrogen deposition on semiarid ecosystems at the Basin-scale in order to find common patterns of response across a wide array of environmental gradients and to finally be able to predict the overall response of these areas to future increases in nitrogen availability.